Space Weather Technical Forecast

Issued on Sunday 20 October 2024 at 13:05 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of G1 peaking into new UTC working week. Initially reducing Chance of R-scale events, rising later in period.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity observed at GOES16 and 18 has remained Moderate, with an M1.7 from AR3854 at 19/1434UTC. There are now up to nine sunspot regions on the disc. The recent most active group, AR3854 is now straddling the western limb and only the easternmost trailing spot is visible. Meanwhile, two new minor unnumbered regions are becoming visible in the far east. Of the remainder of the current regions, the most changed and nominally most complex has been AR3859 in the southwest. This group showed shear and development of leading sunspot area and number, as well as some proliferation of spots within the centre of the group. Changes in other groups were mostly of slow decay or else slow growth, but the latter from starting points of lower complexity.

No Earth-directed CMEs were observed. A coronal dimming in the southeast-centre disc was perhaps associated with some very faint ejecta seen on coronagraphs during the UTC overnight period, however this has been analysed and is felt to be angled sufficiently far southward as to not impinge on Earth.

Solar Wind / Geomagnetic Activity: The solar wind environment showed two main behaviours in the 24 hours: an erratic general increase in many measures to 19/2000UTC, followed by a smoother decrease thereafter. While not conclusive, these effects may be due to skirting the CIR and fast wind influence from northern CH80/+.

Solar winds speeds, as observed at L1 by ACE, rose to a Slightly Elevated peak of 475km/s near 19/2000UTC before declining to 400 by the period's end. The solar wind density was within single figures ppcc throughout, but peaked around the time of the transition between behaviours. The IMF was highest to start the 24 hours at 7nT, gradually decreasing over the ensuing day. The north-south component was mainly negative and ranged as low as -7nT early in the period, becoming smaller-scale and more neutral into the current UTC day. The phi angle was positive (away from the Sun).

The net result of the above solar wind measures was for Quiet to Active geomagnetic indices, peaking with a provisional Kp '4o' in the 18-21UTC interval.

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Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at Background levels.

High energy electron flux (greater than 2MeV) observed by GOES16 was mainly at Normal Background levels. The associated 24-hour fluence was below the Active threshold. The 20/0001UTC observation was 2.06e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is forecast, with isolated M-class flares most probably bookending the four days as AR3854 leaves the disc and expected returning regions gradually arrive.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs currently forecast. The current possible fast wind from CH80 is now waning and further significant geomagnetic activity is now unlikely. A second fast wind from CH82/+ is possible later on day 2 (21 Oct), but more likely on day 3 (22 Oct). This may bring a Chance of Minor geomagnetic storm G1 conditions at peak into the new UTC working week, before activity declines into day 4 (23 Oct). Surrounding activity should be Quiet to Unsettled.

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 is Expected to remain at Background.

High energy electron flux at GOES16 is forecast to remain mainly Low with the associated 24-hour fluence Expected to remain below Active (1e8 total pfu) throughout.

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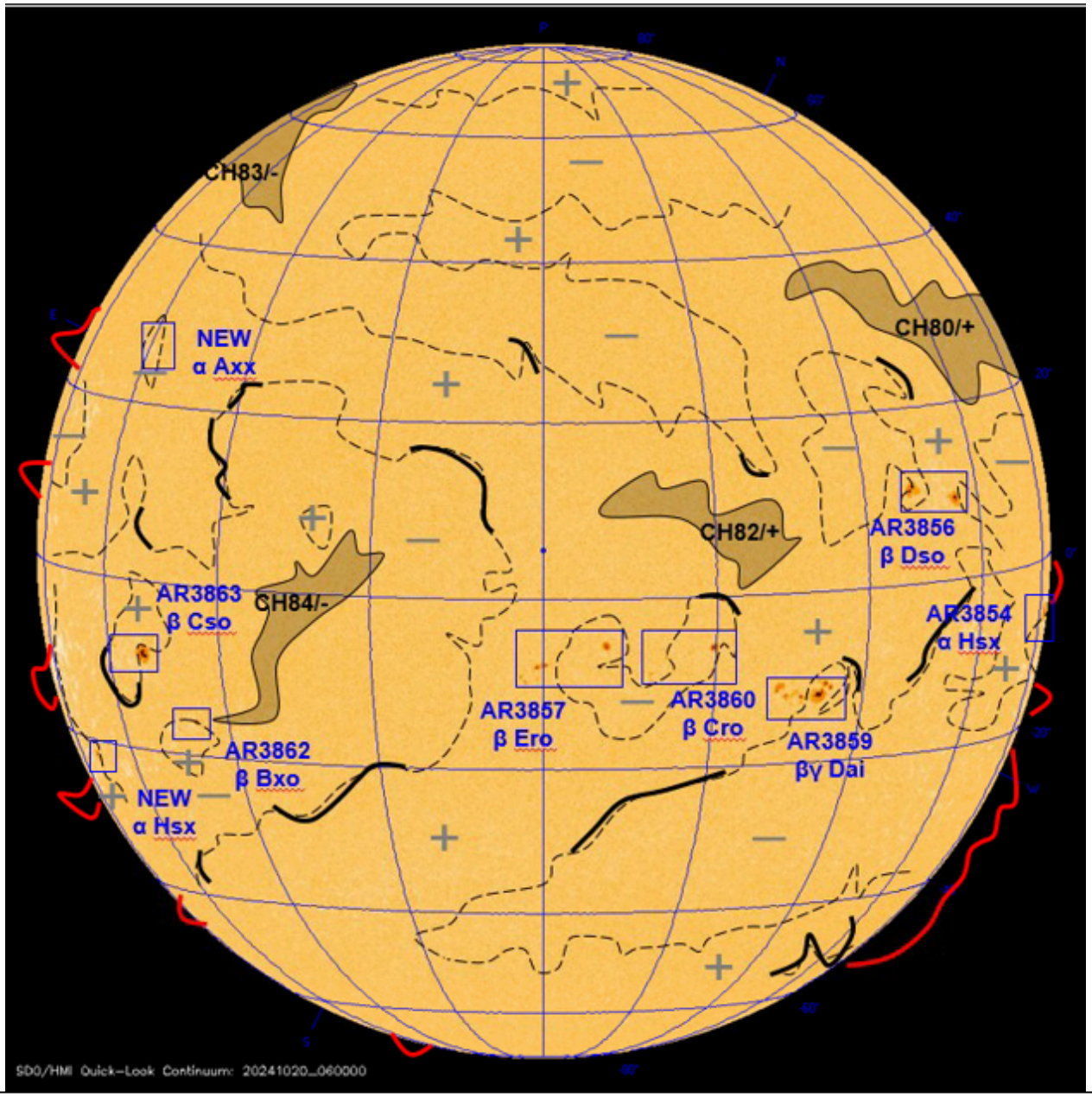
Figure 1: Solar synoptic map, valid 20/0600UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are no Earth-directed CMEs currently forecast.

Solar winds are currently Slightly Elevated but declining, likely due to fading interaction with CH80/+, the large coronal hole in the northwest. The core of the fast wind is likely passing north of Earth, and further interactions with the southern edge are now perhaps mainly passed from L1 signatures. Solar winds conditions should decline to Background into day 2 (21 Oct).

The next enhancement will then be from the likely onset of fast winds from CH82/+. This is a smaller feature, but due to its more equatorial location has a high chance of connection, with the likely arrival for any CIR region expected to occur either late on day 2 or more likely into day 3 (21-22 Oct). A period of Elevated solar winds is then expected to follow, and given G1 Minor Storm intervals were observed on the previous rotation associated with this feature, similar can likely be expected on this occasion. MOSWOC Enlil output does show a weak enhancement possibly from this feature, however this is later (in model space) than currently anticipated given the coronal hole's location, and not considered as good guidance.

Geomagnetic activity is forecast to be mainly Quiet to Unsettled initially but with a chance of isolated Active to G1 Minor Storm intervals from any further enhancement from CH80/+ day 1 (20 Oct). Fast wind onset from CH82/+ is then expected to bring Active to G1 Minor Storm intervals, perhaps later on day 2 (21 Oct), but more likely on day 3 (22 Oct), before activity is expected to decline into day 4 (23 Oct).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	20	50	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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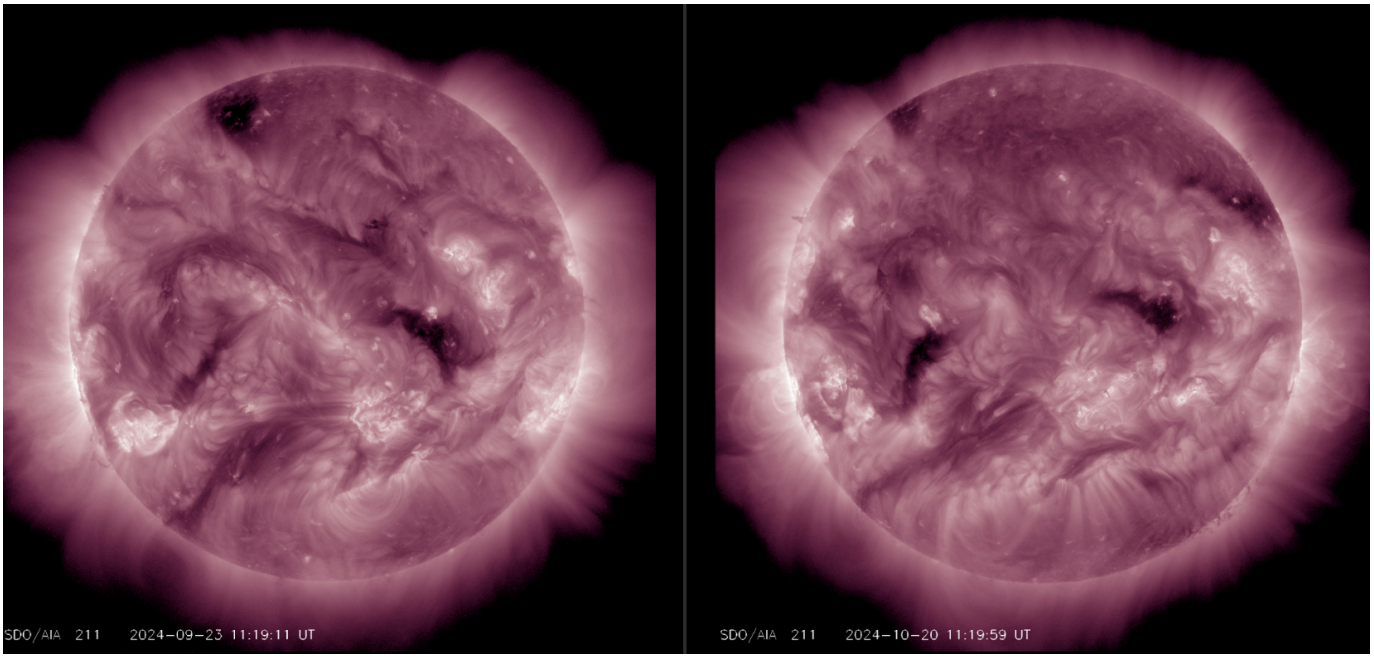
Figure 2: Past rotation in AIA211 imagery, showing similarly-placed predecessor of CH82/+ in the centre-west disc.



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Radio Blackouts - X-Ray Flares

The chances of further Moderate activity - while still present - are now reducing in the immediate term as AR3854 fades from view over the southwestern limb on day 1 (Saturday 20 October). Proper assessment as to its remaining complexity is no longer possible given its current position, but proxies of activity such as bright magnetic looping remain evident in SDO AIA171 imagery. The presence of this group on the limb is the rationale for the retention of an initial Slight Chance of an isolated X-class flare.

Into day 2, (Sunday 21 October) activity is expected to become Low to Moderate, with the remaining regions currently on the disc appearing relatively small and magnetically simple, with little ongoing growth. The main exception to this is AR3859, although this region remains generally stable. A steady increase in activity looks likely into the new UTC working week however, as recurrence, recent CME activity, and far-side sounding data suggest the possible return of several active regions.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	50	30	40	60
Very Active	R3-R5 (X Class)	No	10	5	5	10

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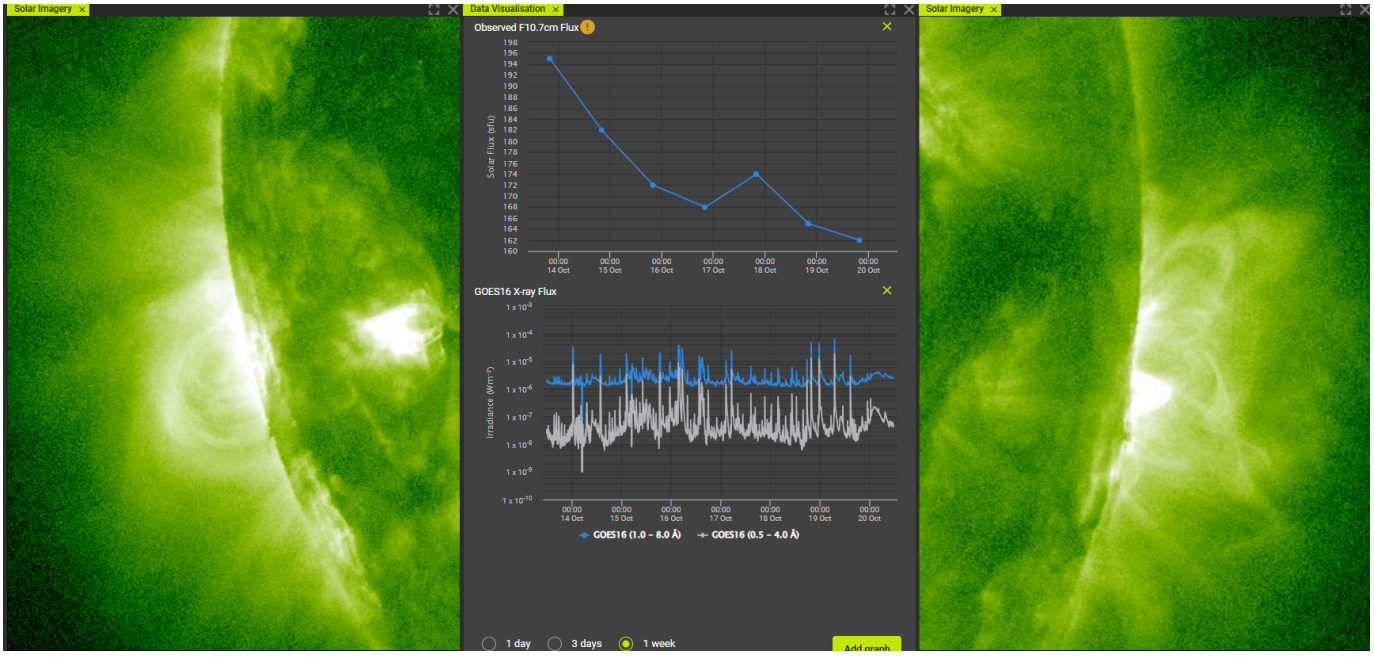
Figure 3: Oncoming eastern limb at 20/1100UTC in AIA094; past seven days in Penticton 10.7cm flux and GOES16 X-ray flares; and off-going western limb image. The recent decline in 10.7cm flux may well reverse into the new UTC working week judging by the oncoming eastern limb bright flux.



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Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES18 is expected to remain at Background. There is a Slight Chance of enhancement in the immediate term due to the recent activity of AR3854 as it moves over the southwestern limb, should any more significant flares occur. Otherwise, there is only a very slight chance of enhancement, with limited flare activity from the other regions currently on the disc.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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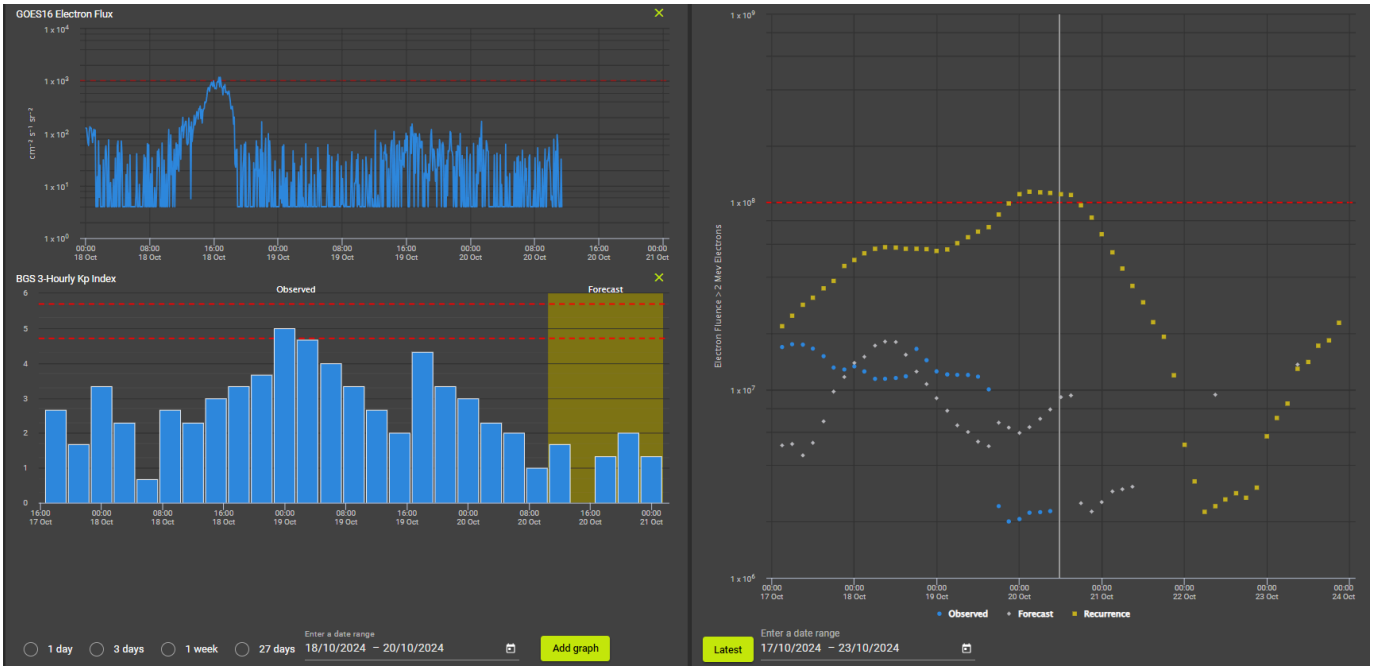
High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES16 has mainly been at Normal Background levels. These flux values are expected to continue, perhaps becoming more persistently background after the recent weak solar wind enhancement, or any further coronal hole fast wind interaction for the remainder of the current UTC day (20 October). The onset of fast winds from central disc CH82 is also likely to suppress values at GEO for a time, but with an eventual chance of rising to Moderate into day 4 (Tuesday 23 October).

The associated 24-hour fluence is expected to remain below Active throughout, even after any flux rise, with MOSWOC REFM thought to be providing generally good guidance.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	5	10
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: 17-20 October inclusive in (clockwise from top left) high energy electron flux at GOES16; 24-hour integrated fleunce (blue dots); and BGS 3-houry Kp indices. Also shown is the REFM forecast (white dots) and persistence trend (yellow).



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